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(12) AUSTRALIAN PATENT ABSTRACT
(19) AU

(11) AU-A-46544/85

AGGLOMERATION OF MINERAL ORE PARTICLES + WITH A MIXT. OF HYDROXY-ETHYL-CELLULOSE AND SODIUM CARBONATE

(54) PELLETIZING IRON ORE USING HYDROXETHYLCELLULOSE AND SODIUM CARBONATE

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(57)

The mixture of hydroxyethylcellulose and sodium carbonate can be used alone or in combination with a suitable carrier. A suitable carrier for the purpose of this invention is a carrier which is water-dispersable and which has no deleterious effect on the binding of the mixture with the mineral ore. Suitable carriers include clays, such as bentonite, gums, such as guar gum, complexing agents, such as sodium tetraborate, or other inorganic salts, such as sodium chloride or calcium carbonate.

Claim

8. A composition for agglomerating mineral ore particles comprising essentially water-soluble hydroxyethylcellulose and sodium carbonate.

9. A composition as recited in claim 8, wherein the sodium carbonate is present in an amount of at least 25%, calculated on the total weight of the composition.

10. A composition as recited in claim 8, wherein the sodium carbonate is present in an equal amount by weight as the hydroxyethyl cellulose.

PATENTS ACT 1952-1973 Form 10

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

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Int. Cl:

Application Number:
Lodged:

Complete Specification—Lodged:
Accepted:
Published:

Priority:

Related Art:

46544/85

TO BE COMPLETED BY APPLICANT

Name of Applicant: UNION CARBIDE CORPORATION, a Corporation organized under the laws of the State of New York, located at Old Ridgebury Road, Danbury, State of Connecticut, 06817, United States of America

Address of Applicant:

Actual Inventor: PAUL CHADWICK PAYNE

Address for Service: Care of: JAMES M. LAWRIE & CO., Patent Attorneys, of 72 Willsmere Road, Kew, 3101, Victoria, Australia

Complete Specification for the invention entitled: A PROCESS FOR AGGLOMERATION OF MINERAL ORE PARTICLES UTILIZING A MIXTURE OF HYDROXYETHYLCELLULOSE AND SODIUM CARBONATE

The following statement is a full description of this invention, including the best method of performing it known to me:—*

*Note: The description is to be typed in double spacing, pica type face, in an area not exceeding 250 mm in depth and 160 mm in width, on tough white paper of good quality and it is to be inserted inside this form.

TITLE

A Process for Agglomeration of Mineral Ore Particles Utilizing a Mixture of Hydroxyethylcellulose and Sodium Carbonate

Field of the Invention

This invention relates to a process for agglomerating or pelletizing mineral ore particles by commingling the mineral ore particles with a binding amount of a mixture of hydroxyethylcellulose and sodium carbonate. This invention also relates to pellets of mineral ore produced by such a process.

Background of the Invention

Certain mineral ores, such as iron ore, must be reduced to finely divided particles for the purpose of benificiation. It is often necessary to agglomerate these particles to facilitate subsequent handling and storage of the mineral ore, e.g., for efficient processing in a blast furnace. This agglomeration helps to prevent dusting, crumbling or caking of the ore. The pellets, sinters or briquettes thus formed from this agglomeration process should be porous and sufficiently strong enough to resist abrasion and crumbling during storage and handling.

Known methods agglomerate the ore particles with binders such as hydroxyethylcellulose, bentonite clay, a mixture of bentonite and a soap, portland cement, sodium silicate or a mixture of an alkali salt of carboxymethyl-cellulose and an alkali metal salt. Use of these known binders, however, is

sometimes disadvantageous. For instance, the pellets formed may lack sufficient resistance to abrasion; or the pellets may contain undesirable levels of contaminating compounds; or an undesirably high ratio of binder to ore may be necessary for effecient agglomeration.

Accordingly, it is an object of the present invention to provide a process for agglomerating mineral ore particles which does not suffer from the disadvanteges described above. A particular object of this invention is to provide a novel process for agglomerating mineral ore particles which comprises commingling the mineral ore particles with a binding amount of a mixture of hydroxyethylcellulose and sodium carbonate. Another object of this invention is to provide novel mineral ore pellets produced by this process.

Description of the Invention

This invention relates to a process for agglomeration of mineral ore particles which comprises commingling the mineral ore particles with a binding amount of a mixture of hydroxyethylcellulose and sodium carbonate, in the presence of water. The binding amount of the mixture will vary depending upon the agglomeration method to be used, the nature of the ore and the properties desired in the pellets of the mineral ore thus formed. In general the binding amount of the mixture will be an amount greater than about 0.01%, calculated on the weight of the dry ore. For iron ore particle agglomeration the preferable amount of

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the mixture is greater than about 0.05%, calculated on the weight of the dry ore.

In principal all types of essentially water-soluble hydroxyethylcellulose can be used to produce mixtures useful in the process of this invention.

The mixture of hydroxyethylcellulose and sodium carbonate can be used alone or in combination with a suitable carrier. A suitable carrier for the purpose of this invention is a carrier which is water-dispersable and which has no deleterious effect on the binding of the mixture with the mineral ore. Suitable carriers include clays, such as bentonite, gums, such as guar gum, complexing agents, such as sodium tetraborate, or other inorganic salts, such as sodium chloride or calcium carbonate.

The mixture of hydroxyethylcellulose and sodium carbonate contains sodium carbonate in an amount of at least 2%, preferably greater than 25%, calculated on the total weight of the mixture. Preferably the concentration of sodium carbonate will vary from about 25% to about 75%, more preferably from about 30% to 65% and most preferably from about 40% to about 60%, calculated on the total weight of the mixture of hydroxyethylcellulose and sodium carbonate.

The water present in the agglomeration mixture may be adjusted during or prior to addition of the mixture of hydroxyethylcellulose and sodium carbonate to the ore. The amount of water present is the amount necessary for satisfactory agglomeration. This amount will vary depending on

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type of mineral ore used and the desired properties of the agglomerated ore particles but, in general, is equal to or greater than about 5% of the wet mixture. Preferably the amount of water ranges from about 5% to about 20% of the wet mixture. For proper plasticity of iron ore pellets the preferred amount of water ranges from about 7% to about 12% of the wet mixture.

Commingling the mineral ore particles with the mixture of hydroxyethylcellulose and sodium carbonate can be accomplished in any manner commonly used for agglomeration purposes, such as in a conventional disc pelletizer or rolling drum pelletizer, or in a roll press.

The pellets thus formed are referred to as "green" or "raw" pellets. These pellets possess a limited amount of structural strength. Consequently, the green pellets are then dried for about 0.5 hour to about 24 hours, preferably from about 1 hour to about 2 hours, at elevated temperatures, preferably between about 100°C to about 300°C. During this drying step the pellets reach their maximum strength. The strength and quality of the ore pellet is usually characterized by quantities such as drop number and compressive strength.

The present invention will be further described in the following examples.

Example I

Equal amounts by weight of hydroxyethylcellulose (solution viscosity of 6000 centipoise as measured on a 1% aqueous solution on a

Brookfield Viscometer on a No. 4 spindle at 30 rpm) and sodium carbonate were uniformly mixed in a twin shell blender to be used as the binder composition.

Finely divided iron ore particles were initially homogenized and moisturized with water in a drum until the moisture content of the ore was about 4%. Samples (30 Kg. each) of the moistened ore were manually mixed with various amounts of the binder composition for one minute and then uniformly fed into a disc pelletizer. Water was fed to the disc by a proportioning pump through two sprays to attain the desired percentage of moisture in the pellets (see Table 1).

The pellets thus produced ranged in size from 10 to 14 mm. The "green" pellets for each respective concentration of binder and water were segmented into lots of 15 each for testing:

I. Drop Test

This test consisted of dropping the green pellets from a height of 450mm onto an iron base. The average number of drops required to cause fracture of the 15 pellets in the lot is the drop number.

II. Compressive Strength

A. Green Pellets

This test consisted of loading each pellet to breakage with the aid of a hydraulic press moving at a constant speed of 50mm/min. The number represents the average compressive strength in grams required to break the pellets of each lot.

B. Dry Pellets

Green pellets produced by the agglomeration process were placed in an oven and dried for 2 hours at about 110°C, and then subjected to the compressive strength test described above.

The results of these tests are summarized in Table I.

TABLE I

Quality of Pellets With and Without Binder
(15 pellets per test)

Test No.	Binder* Addition (g/t)	Moisture (%)	Drop Number	Compressive Strength(g) Green	Dry
1	0	7.50	2.00	450	600
2	0	8.30	2.00	620	820
3	200	7.51	1.87	600	830
4	200	7.87	1.80	670	840
5	200	8.03	2.00	840	950
6	200	8.26	2.40	740	910
7	200	8.37	2.13	830	970
8	200	8.52	2.60	980	1150
9	350	7.95	2.27	830	1460
10	400	7.73	2.20	650	1310
11	400	7.80	1.87	730	1260
12	400	8.20	2.93	1010	1450
13	400	8.38	3.67	1180	1500
14	450	8.13	2.60	810	1460
15	600	7.70	2.13	800	1810
16	600	7.93	2.60	900	1690
17	600	8.13	3.07	900	1540
18	600	8.60	4.33	720	1960
19	600	8.79	4.13	980	1930
20	600	9.05	2.67	780	1470
21	1000	8.41	3.53	750	3690
22	1500	8.70	7.20	830	5190

* Grams of the 50/50 blend of hydroxyethyl cellulose and sodium carbonate per ton of iron ore

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The procedure described above was repeated using a mixture of bentonite clay and the binding composition as the pelletizing agent. The results of this test are summarized in Table II.

TABLE II*

Quality of Pellets Produced With Bentonite Addition

Binder and Bentonite+ (g/t)	Moisture (%)	Drop Number	Compressive Strength(g) Green	Dry
Bentonite 1700 Binder 300	8.53	2.07	800	1850

* 15 pellets tested

+ Grams of Bentonite and binder per ton of iron ore

EXAMPLE II

The following binding compositions were prepared by uniformly mixing the ingredients (percentages are all by weight):

A. 50% hydroxyethylcellulose (HEC I) (solution viscosity of 6000 centipoise as measured on a 1% aqueous solution on a Brookfield Viscometer on a No. 4 spindle at 30 rpm)
50% sodium carbonate

B. 50% hydroxyethylcellulose (HEC II) (solution viscosity of 300 centipoise as measured on a 2% aqueous solution

on a Brookfield Viscometer on a NO. 2 spindle at 60 rpm)

50% sodium carbonate

C. 35% HEC I

65% sodium carbonate

D. 25% HEC I

25% Guar gum

50% sodium carbonate

Finely divided taconite ore particles (~8.5% moisture) were mixed with one of the binding compositions described above for each test. Concentration of the binding composition for all tests was 1.55 pounds per ton of taconite ore. After mixing, the ore plus binding composition was uniformly fed into a rotating balling tire for pelletizing. Water was added as required as an atomized mist. The pellets thus formed ranged in size from 12-14mm. The pellets were then segmented into lots of 20 each for testing.

I. Drop Test

A. Green pellets

Same test as described in Example I except that the pellets were dropped from a height of 18 inches.

B. Dry Pellets

Green pellets were placed in an oven and dried for 30 minutes at 350° F (176°C). The dried pellets were then subjected to the drop test described above.

II. Compressive Strength

A. Green Pellets

This test consisted of loading each pellet to breakage using a Chatillon Spring Tester of 25

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lb. range at a constant speed of 0.1 in./sec. The number represents the average compressive strength in pounds required to break the pellet of each lot.

B. Dry Pellets

Green pellets were placed in an oven and dried for 30 minutes at 350°F(-176°C). The dried pellets were then subjected to the compressive strength test described above.

The results of these tests are summarized in TABLE III.

TABLE III

Quality of Pellets
Using Different Binding Compositions
(Average of 20 pellets per test)

Binding Composition	Moisture %	Drop Number		Compressive Strength*	
		Green	Dry	Green	Dry
A	-	3.65	2.76	3.57	4.54
B	8.79	3.45	2.55	3.39	4.52
C	8.49	2.61	2.15	3.06	3.23
D	8.07	3.36	3.65	3.16	4.35

* Average compressive strength in pounds
\- Not determined

EXAMPLE III

Binding compositions comprising various blends of hydroxyethylcellulose (solution viscosity of 6000 centipoise as measured on a 1% aqueous solution on a Brookfield Viscometer on a No. 4 spindle at 30 rpm) and sodium carbonate were

prepared by uniformly mixing the hydroxyethylcellulose and sodium carbonate as follows (percentages are all by weight):

E. 50% hydroxyethylcellulose
50% sodium carbonate

F. 60% hydroxyethylcellulose
40% sodium carbonate

G. 75% hydroxyethylcellulose
25% sodium carbonate

H. 100% hydroxyethylcellulose
0% sodium carbonate

Finely divided taconite ore particles (~8.5% moisture) were mixed with one of the binding compositions described above for each test. Concentration of the binding composition in the ore varied for each composition but the percentage of hydroxyethylcellulose in the ore remained the same, i.e., 0.78 lbs. per metric ton of ore. After mixing, the ore plus binding composition was pelletized and tested as described in Example II.

The results of these tests are summarized in Table IV.

TABLE IV

Quality of Pellets Using Different Blends of Hydroxyethylcellulose and Sodium Carbonate as Binders*

Binding Composition	LBS/ - Metric Ton	Drop Number Wet	Drop Number Dry	Compressive Strength(LBS) Wet	Compressive Strength(LBS) Dry	Moisture %
E	1.55	3.2	2.9	3.5	4.8	8.3
F	1.30	3.1	2.1	3.3	3.5	8.6
G	1.04	3.7	2.0	3.1	2.9	8.7
H	0.78	3.6	2.0	3.5	3.1	8.3

*Average of 20 pellets per test

The process of this invention is preferably employed for iron-containing ores and ore concentrates, such as magnetite and hematite concentrates, natural ores and pyrite residues but the process is also suitable for use with non-ferrous ore materials.

Although the method of this invention has been described generally for preparation of pellets of mineral ore it will be understood by those skilled in the art that this method is equally applicable for the preparation of other agglomerated forms, such as briquettes and sinters.

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The claims defining the invention are as follows:-

1. A process for agglomerating mineral ore particles which comprises commingling the mineral ore particles with a binding amount of a mixture of essentially water-soluble hydroxyethylcellulose and sodium carbonate, in the presence of water.

2. A process as recited in claim 1, wherein the binding amount of the mixture of hydroxyethyl cellulose and sodium carbonate is greater than 0.01%, calculated on the weight of the dry mineral ore.

3. A process as recited in claim 2, wherein the sodium carbonate is present in an amount of at least 25%, calculated on the total weight of the mixture of hydroxyethylcellulose and sodium carbonate.

4. A process as recited in claim 3, wherein the sodium carbonate is present in an equal amount by weight as the hydroxyethylcellulose.

5. A process as recited in claim 4, wherein the mineral ore is iron ore.

6. A process as recited in claim 5, wherein the binding amount of the mixture of hydroxyethylcellulose and sodium carbonate is an amount greater than about 0.05%, calculated on the dry weight of the iron ore.

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7. The agglomerated product of the process of any one of claims 1 to 6.

8. A composition for agglomerating mineral ore particles comprising essentially water-soluble hydroxyethylcellulose and sodium carbonate.

9. A composition as recited in claim 8, wherein the sodium carbonate is present in an amount of at least 25%, calculated on the total weight of the composition.

10. A composition as recited in claim 8, wherein the sodium carbonate is present in an equal amount by weight as the hydroxyethyl cellulose.

11. A process for agglomerating mineral ore particles substantially as described with reference to the examples.

12. A composition for agglomerating mineral ore particles substantially as described with reference to the examples.

DATED this 20 day of August 1985.

JAMES M. LAWRIE & CO.

by: Jeffrey A. Ryder

Patent Attorneys for
UNION CARBIDE CORPORATION

86183073

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952

86183073

A81 M24

CONVENTION APPLICATION FOR A PATENT

We, UNION CARBIDE CORPORATION, a Corporation organized under the laws of the State of New York, located at Old Ridgebury Road, Danbury, State of Connecticut, 06817, United States of America, hereby apply for the grant of a patent for an invention entitled, A PROCESS FOR AGGLOMERATION OF MINERAL ORE PARTICLES UTILIZING A MIXTURE OF HYDROETHYLCELLULOSE AND SODIUM CARBONATE, which is described in the accompanying complete specification.

~~AU-CO~~
AU 85-46544/86

This application is a Convention Application and is based on the application for a patent or similar protection made in the United States of America, on 20 November 1984, numbered 673,286.

FEE STAMP TO VALUE OF $155 ATTACHED
MAIL OFFICER

INV: P.C. PAYNE

Our address for service is: Care of JAMES M. LAWRIE & CO., Patent Attorneys, of 72 Willsmere Road, Kew, 3101, Victoria, Australia.

PAT. IRON
AGGLOMERATING MINERAL ORE PARTICLES BY MIXING ORE WITH WATER-SOLUBLE HYDROXY-ETHYLCELLULOSE AND SODIUM CARBONATE IN PRESENCE OF WATER

DATED this 20 day of August 1985.

AUSTRALIAN
22 AUG 1985
PATENT OFFICE

JAMES M. LAWRIE & CO.

by: Jeffrey A. Ryder

Patent Attorneys for
UNION CARBIDE CORPORATION

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To: The Commissioner of Patents
COMMONWEALTH OF AUSTRALIA

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Convention Application made by[1] UNION CARBIDE CORPORATION

(hereinafter referred to as the applicant) for a Patent for an invention entitled:[2] A PROCESS FOR AGGLOMERATION OF MINERAL ORE PARTICLES UTILIZING A MIXTURE OF HYDROXYETHYLCELLULOSE AND SODIUM CARBONATE

I,[3] Edward G. Grier of Old Ridgebury Road, Danbury, State of Connecticut, 06817, United States of America do solemnly and sincerely declare as follows:

1. I am authorised by the applicant for the patent to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was made in[4] the United States of America on the 20th day of November 1984, by Paul Chadwick Payne numbered 673,286

on the ____ day of ____ 19__, by ____

3.[5] Paul Chadwick Payne, residing at 100 Queensferry Road, Cary (27511), State of North Carolina, United States of America.

is/are the actual inventor of the invention and the facts upon which the applicant is entitled to make the application are as follow:

The applicant is the assignee of Paul Chadwick Payne by virtue of deed of assignment dated November 19, 1984; made between the said Paul Chadwick Payne and Union Carbide Corporation

4. The basic application referred to in paragraph 2 of this Declaration was ____ the first application made in a Convention country in respect of the invention the subject of the application.

DECLARED at Danbury, Ct., United States of America this 8th day of August 19 85

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UNION CARBIDE CORPORATION

[6] Edward G. Grier
Authorized Agent

To: THE COMMISSIONER OF PATENTS.